



THE
DESCRIPTION
OF A

Pocket Microscope,

WITH

The APPARATUS thereunto belonging.

As made by

J O H N C U ^K F F,

*At the Sign of the Reflecting Microscope, exactly
opposite Serjeant's-Inn Gate in Fleet-Street,
London.*

AB. AB. **R** Epresents the Body of the *Microscope*,
made either of Silver, Brass, or Ivory.
CC. A long fine-threaded male Screw,
that turns into the Body of the *Microscope*.

D. A Convex Glass at the End of the said Screw, to
collect the Rays of Light, and point them upon the
Object.

* Two Concave Pieces of thin Brass, with Holes of
different Diameters in the Middle of them, to cover
the said Glass, and thereby diminish the Aperture,
when the greatest Magnifiers are used.

EE. Three thin Plates of Brass within the Body of the
Microscope, one whereof is bent semi-circularly in
the Middle, so as to form an arched Cavity for the
Reception of a Tube of Glass.

A 2

F. A

- F. A Piece of Wood or Ivory, arch'd in the manner of the said Plate, and fasten'd thereto.
- G. The other End of the *Microscope*, where a hollow female Screw is adapted to receive the different Magnifiers.
- H. A spiral Spring of Steel or Brass between the said End G and the Plates of Brass, intended to keep the Plates in a due Position, and counteract against the long Screw CC.
- I. A small turn'd Handle for the better holding of the Instrument, to screw on or off at pleasure.

To this *Microscope* belong seven different magnifying Glasses; six of which are set either in Silver, Brass, or Ivory, as in the Figure K, and are mark'd 1, 2, 3, 4, 5, 6. Observe the lowest Numbers are the greatest Magnifiers.

- L. is the seventh *Magnifier*, set in the manner of a little Barrel, to be held in the Hand, for the viewing any larger Object.
- M. Is a flat Slip of Ivory, call'd a *Slider*, with four round Holes thro' it, wherein to place Objects between two Glasses or Talks.

Eight such Ivory Sliders, and one of Brass, usually go along with this *Microscope*; but whosoever pleases to make a large Collection of Objects may have as many as he desires.

The Ivory Sliders sold herewith are number'd 1, 2, 3, 4, 5, 6, 7, 8, and contain the Objects following. Begin with the Hole in each Slider next the +,

- No 1. Down of a Moth's Wing.
Farina of Mallows.
Farina of the Sun-flower.
Seed of Fern.
- No 2. Hair of a Mouse.

Human

- Human Hair.
Wool of a Mole.
Down of a Thistle.
No 3. Scales of a Perch.
Scales of a Soal-fish.
Scale of a Cod.
Human Skin.
No 4. Pith of a Rush.
A piece of Cork.
A piece of Sponge.
A piece of Pith of Elder.
No 5. The Eye of a Fly.
The Wing of a Fly.
Pieces of a Feather.
A piece of the Wing of a Butterfly.
No 6. Poppy Seed.
A Louë.
A small Spider.
A small Caterpillar.
No 7 and 8 are Sliders without Objects, for the viewing the Animalcula in Fluids, or the Farina of Vegetables, &c.

The Brass Slider is to confine any small living Object, that it may be view'd without crushing or destroying it.

- N. Is a Forceps or pair of Plyers, for the taking up of Insects, or other Objects, and adjusting them in the Glasses.
O. A little Hair Brush or Pencil, wherewith to put upon the Talks or Isinglass any small Drop of Liquid one would examine.

When you design to view an Object, thrust the Ivory Slider (in which the said Object is placed) between the two flat Brass Plates EE, observing always to put that Side of the Slider where the Brass Rings are, farthest from your Eye: Then screw in the magnifying Glass
you

you intend to use at the End of the Instrument G, and looking thro' it against the Light, turn the long Screw CC till your Object is brought to the true focal Distance : which you will know by its then appearing perfectly clear and distinct. The Way of examining any Object accurately, is, to look at it first through a Magnifier that will shew the Whole thereof at once, and afterwards to inspect the several Parts more particularly with one of the greatest Magnifiers : For thus you will gain a true Idea of the Whole, and of all its Parts ; And tho' the greatest Magnifiers can shew but an exceeding minute Portion of any Object at once, such as the Claw of a Flea, the Horn of a Louse, or the like, yet by gently moving the Slider that contains your Object, the Eye will gradually behold it all ; and if any Part should be out of Distance, the Screw CC will easily reduce it to the true Focus.

As the Object must be brought very near the Glasses when you employ the greatest Magnifiers, be particularly careful not to let your Slider rub against them as you move it in or out, lest you scratch and spoil your Glasses : This easily may be prevented by a few turns of the Screw CC, which will give you Room enough.

You may change the Objects in your Sliders for what others you think proper, by taking out the Brass Rings with the Point of a Penknife : The Talks will then fall out, if you but turn the Sliders ; and after putting what you please between them, by replacing the Brass Rings you will fasten them as they were before.

The Sliders that are furnish'd with Talks, but have no Objects, are intended to be always in Readiness for the Examination of Fluids, Salts, Sand, Powders, the Farina of Flowers, or any other casual Objects of such Sort as need only be applied to the Outside of the Talk.

If a little Hay, or some Corns of Pepper, be steeped in Water a few Days, in an open Vessel, it will abound
with

with living Creatures, so exceedingly minute, that, according to *Leeuwenhoek's* Computation, eight millions two hundred and eighty thousand Animalcula will be contain'd in one Drop of Water : So that on a Comparifon, was a Grain of Sand broken into eight millions of Parts, each Part would be larger than one of thefe Infects.

P. Is a Tube of Glafs contrived to confine living Objects, in order to discover the Blood, as it streams along the Veins and Arteries.

The Circulation of the Blood may be eafieft feen in the Tails or Fins of Fifhes ; in the fine Membrane between a Frog's Toes ; or (beft of all) in the Tail of a Water-Newt. If your Object be a fmall Fifh, place it within the Tube, and fpread its Tail or Fin againft the Side thereof ; if a Frog, chufe fuch a One as can but juft be put into your Glafs Tube, and with a Pen or Stick, expand the transparent Membrane between the Toes of the Frog's hind Foot as wide as you are able. When your Object is fo adjusted that no Part of it can intercept the Light from the Place you intend to view, unfcrew the long Screw CC, and thruft your Tube into the arched Cavity, quite thro' the Body of the *Microscope* ; then fcrew it to the true focal Distance, and you will fee the Blood paffing along its Veffels with a rapid Motion, in the Veins one Way, and in the Arteries another : and in fome of the minuteft Branches the Globules of the Blood may be difcerned paffing on fingly and fucceffively.

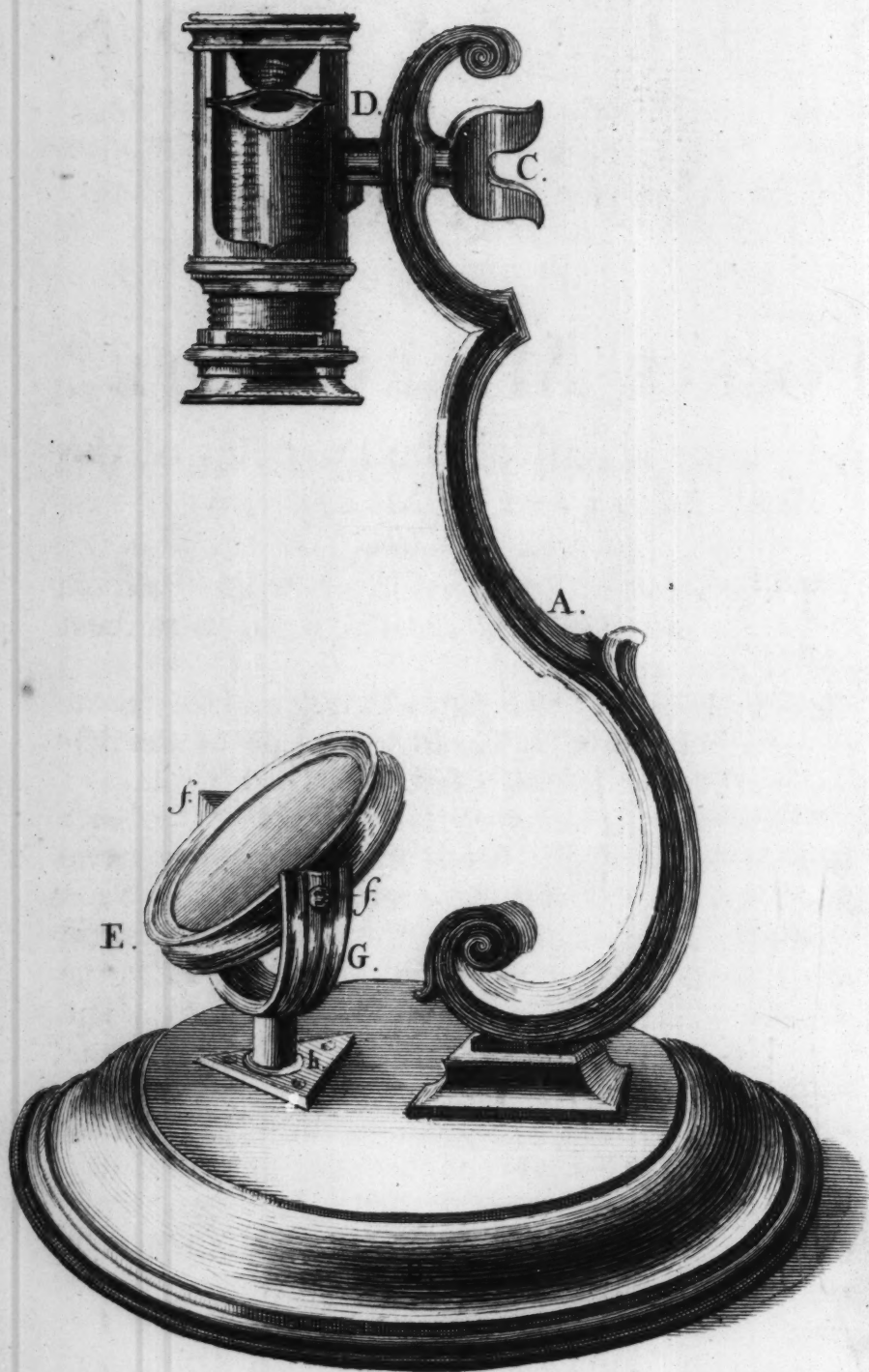
Make ufe of the 3d or 4th Magnifier for Frogs or Fifhes ; but for the Tail of Water-Newts the 5th or 6th will do, becaufe the Globules of their Blood are twice as large as thofe of Frogs or Fifh. The 1ft or 2d Magnifier cannot well be employed to this Purpofe ; for the Thicknefs of the Tube wherein the Object lies,
will

will scarce admit its being brought so near as the focal Distance of the Magnifier,

The best Light for viewing Objects, is a clear Sky-Light, the Sun shining on any white Thing, or the Reflection of its Rays from a Looking-Glass: Candle Light is also good; but People not much practised in *Microscopes* find it somewhat difficult to hit the Candle exactly. But whatever Light you use, be very careful not to shade the Object by your Hat or Perriwig, for the best of Glasses can shew but little, unless the Object be at a just Distance, and have a sufficient Light.

The single *Microscope* above described, may be formed into a double one, by screwing to it a Tube with an Eye Glass at the End thereof. Also, by the Addition of a particular *Apparatus* contrived by Mr Cuff for that Purpose, it composes the best Kind of *Solar Microscope*; that is, by applying it to a small Hole cut in the Shutter of a Window, and directing the Sun-Beams thro' it, the exact Form or Image of any transparent Object will be thrown upon a Linen Sheet, or Screen of Paper, placed opposite thereto, within the Room (which must be made quite dark) in a most beautiful and delightful Manner, and enlarged to a most amazing Size; for this Way, a Louse may be magnified to the Length of 2, 3, 4, or 5 Feet, and all other Objects in a like Proportion.

Mr Cuff has likewise a new invented *Microscope* of a particular Structure, for viewing *Opake* Objects. — All former Contrivances for *Opake* Objects have been greatly deficient and unsatisfactory, by reason of their wanting Light; but by this Method, the Object is so strongly illuminated, that it may be examined, with all imaginable Exactness, Ease and Pleasure.



Barbury del.

J. Wigley Sculp.

THE
DESCRIPTION
OF A

New Invention,

To fix the

Pocket MICROSCOPE,

And make it answer the Purposes of the
large REFLECTING MICROSCOPE.

A. **I**S a Scrole of Brass, fixt in an upright Position, on a round wooden Pedestal B, so as to stand perfectly firm and steady.

C. Is a brass Screw, that passes through a Hole in the upper Limb of the Scrole into the Side of the *Microscope* D, and screws it fast to the said Scrole.

E. A Concave Looking-glass or Speculum, set in a Box of Brass, which hangs in the Arch G by two small Screws, *ff*, that screw into the opposite Sides thereof. At the bottom of the said Arch is a Pin of the same Metal, exactly fitted to a Hole *b*, in the wooden Pedestal made for the Reception of the said Pin. As the Arch turns on this Pin, and the Speculum turns on the Ends of the Arch, it may, by this twofold Motion, be easily adjusted in such a Manner as to reflect the Light of the Sky, the Sun, or a Candle, directly upwards thro' the *Microscope* that is fixt perpendicularly over it, and, by so doing, may be made to answer all the Ends of the *Reflecting Microscope*. The Body of the *Microscope* may also be fixt horizontally, and Objects viewed in that Position by any Light you chuse; which is an Advantage the large *Reflecting Microscope* has not.

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THE
DESCRIPTION
OF A
MICROSCOPE
FOR
Opake Objects;

As Made and Sold by

J O H N C U F F,

At the Sign of the *Reflecting Microscope* directly
againſt *Serjeant's-Inn* Gate, in *Fleet-Street*,
London.

PEOPLE curious in Microſcopical Obſervations, have frequently lamented the great Difficulty of examining *Opake Objects* with any conſiderable Degree of Exactneſs or Satisfaction; for, in all the Contrivances they had met with to that Purpoſe, as the Object muſt be brought to the Focus of the Magnifier, in order to take a View thereof, the Nearneſs of the Inſtrument neceſſarily intercepted the Light from falling on it, and in ſuch a Manner overſhadowed it, as to render its Appearance obſcure and undiſtinct. And notwithstanding Means were tried to caſt Light upon the Object, from the Sun or a Candle, by a Convex Glaſs placed on the Side thereof, the Rays from either could be thrown upon it, in ſuch an acute Angle only, as ſerved to give a confuſed Glare, but were inſufficient to afford a clear and perfect View of the Object.

But

But an effectual Way has been happily found out to remedy this Inconvenience; and that is, by fixing a Double-convex Lens, or Magnifier, in the Center of a Concave Speculum, whose Focus is near the same as the Focus of the same Lens; whereby a strong Light is reflected directly upon the Object, and every Part thereof may be examined with the utmost Exactness and Delight.

The following *Apparatus* (whose chief Parts are of Brass or Silver) has been contrived for the better making use of the said Invention.

Through the first Side A, passes a fine Screw B, the other End whereof is fastened to the moveable Side C.

D. Is a Nut adapted to the said Screw, by the turning of which the two Sides AC are gradually brought together.

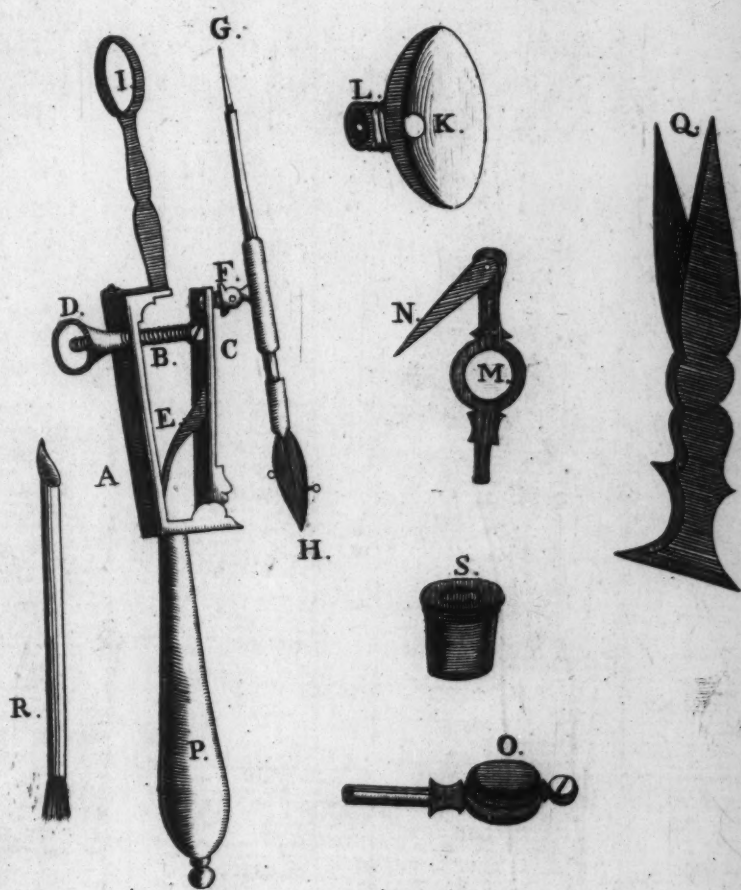
E. Is a Spring of Steel that separates the said two Sides, when the Nut is unscrewed.

F. A Piece of Brass turning round in a Socket, whence proceeds a small Spring Tube moving upon a Rivet, through which Tube there runs a Steel Wire, one End whereof terminates in a sharp Point G, and the other hath a Pair of Pliers H fasten'd to it. — The Point and Pliers are to thrust into, or take up and hold any Insect or Object; and either of them may be turned upwards, as may be most convenient.

I. A Ring of Brass, with a Female Screw within in, mounted on an upright Piece of the same Metal, which turns round on Rivet, that it may be set at a due Distance when the least Magnifiers are used.

This Ring receives the Screws of all the Magnifiers.

K. A Concave Speculum of Silver, very highly polish'd, in the Center of which a Double-convex Lens is placed, with proper Apertures to look through it. On the Back of this Speculum a Male Screw L is fitted





fitted to the Brass Ring I, to screw in the said Ring at Pleasure.

There are four of these Concave Specula, of different Depths, adapted to four Glasses of different magnifying Powers, which are to be made use of as different Kinds of Objects may require. Observe the greatest Magnifiers are known by having the least Apertures.

- M. A round Object Plate, one Side white and the other black, intended to render Objects the more visible, by placing them, if black, on the white, and if white on the black Side. A Steel Spring N turns down on each Side, to make any Object fast, and at one End of the Object Plate is a hollow Pipe to screw it on the Needle's Point G.
- O. A small Box of Brass, with a Glass on each Side, contrived to confine any living Object, in order to examine it: This also has a Pipe to screw upon the End of the Needle G.
- P. A turned Handle of Wood to screw into the Instrument when it is made use of.
- Q. A Pair of Brass Pliers to take up any Object, or manage it with Conveniency.
- R. A soft Hair Brush for the taking a Drop of any Liquid, applying it to the Isinglass, to view the Animacula.
- S. A small Ivory Box for Talks to be placed occasionally in the small Brass Box O.

When you would view any Object, screw the Speculum with the Magnifier you intend to use, into the Brass Ring I; place your Object either on the Needle G, in the Pliers H, on the Object Plate M, or in the Brass hollow Box O, as may be most convenient according to the Nature of it; then holding up your Instrument by the Handle P, look against the Light thro' the magnifying Lens, and by Means of the Nut D, together with the Motion of the Needle by raised,

naging its lower End, the Object may be turned about, raised, or depressed, brought nearer the Glass, or put farther from it, till you hit the true focal Distance, and the Light be reflected from the Speculum strongly upon the Object, by which Means it will be shewn in a Manner surprisingly distinct and clear. And for this Purpose, the Light of the Sky, Sun-shine, or a Candle, will answer to your Satisfaction.

This *Microscope* is principally intended for *Opake Objects*, but transparant ones may also easily be view'd by it, observing only, that when such come under Examination, it will not always be proper to throw on them the Light reflected from the Speculum; for the Light transmitted through them, meeting the reflected Light, may together produce too great a Glare. A little Practice will teach how to regulate these two Lights to good Advantage.

There is Reason to expect great Discoveries may be made by the *Apparatus* above described. The famous Mr *Leewenboek*, in all his Observations, used only such single Glasses, placed somewhat in the same Manner, but without the Advantage of our reflected Light, as is evident from his own Accounts, and also from twenty-six of them, given as a Legacy to the *Royal Society*: And, in a Letter to the said Society, he declares, his having found, in a long Course of Experience, “ that
“ the most considerable Discoveries were to be made
“ with such Glasses, as, though magnifying but moderately, exhibit the Object with the most perfect
“ Brightness and Distinction.”

A
DESCRIPTION
OF THE
SOLAR,
OR,

Camera Obscura MICROSCOPE,

As Made and Sold by

JOHN CUFF,

At the Sign of the *Reflecting Microscope*, directly
against *Serjeant's-Inn Gate* in *Fleet-Street*,
London.

WHEN the *Microscope* is made use of in the
new Way, that is, by directing the Sun's Rays,
through a Tube, upon some Object plac'd within and
near the End of the said Tube, the Image, or Picture
of the Object is thrown in a most exact, beautiful, and
surprizing Manner, upon a white Paper Screen, or
Linen Sheet, placed on purpose to receive the same:
And thus all Microscopical Objects, that are transpa-
rent, may be examin'd with a great deal of Ease and
Pleasure, since hereby they become exceedingly mag-
nified, beyond what they have ever been by any other
Contrivance; and with these farther Advantages, that
several People may view them at the same Time; that
the weakest Eyes are in no Danger of being fatigu'd
or strain'd; and that even such as have no Skill in

B

Drawing,

Drawing, may easily trace out the Figure of any Object, with a Pen or Pencil, as it lies before them.

The *Microscope* employ'd for this service, is that already describ'd in the first and second Plates : The other Parts of the *Apparatus* are represented in the present Plate, and are as follows.

A. A square Frame of Mahogany, which two long Screws (assisted by a couple of Nuts 1. 1.) fasten firmly to a Window-shutter : the two Nuts being let into the Shutter, and screw'd fast thereto.

In the Middle of this Frame is a round Hole, made to receive a circular Piece of Mahogany B, whose Edge, that projects a little beyond the Frame, consists of a shallow Groove 2. wherein a Cat-Gut runs 3. which Cat-Gut turning also round a brass Pulley 4. (the Handle whereof 5. passes through the Wood-work) and being cross'd thereon, affords an easy Motion for turning round the circular Piece of Mahogany, with all the Parts affix'd thereto.

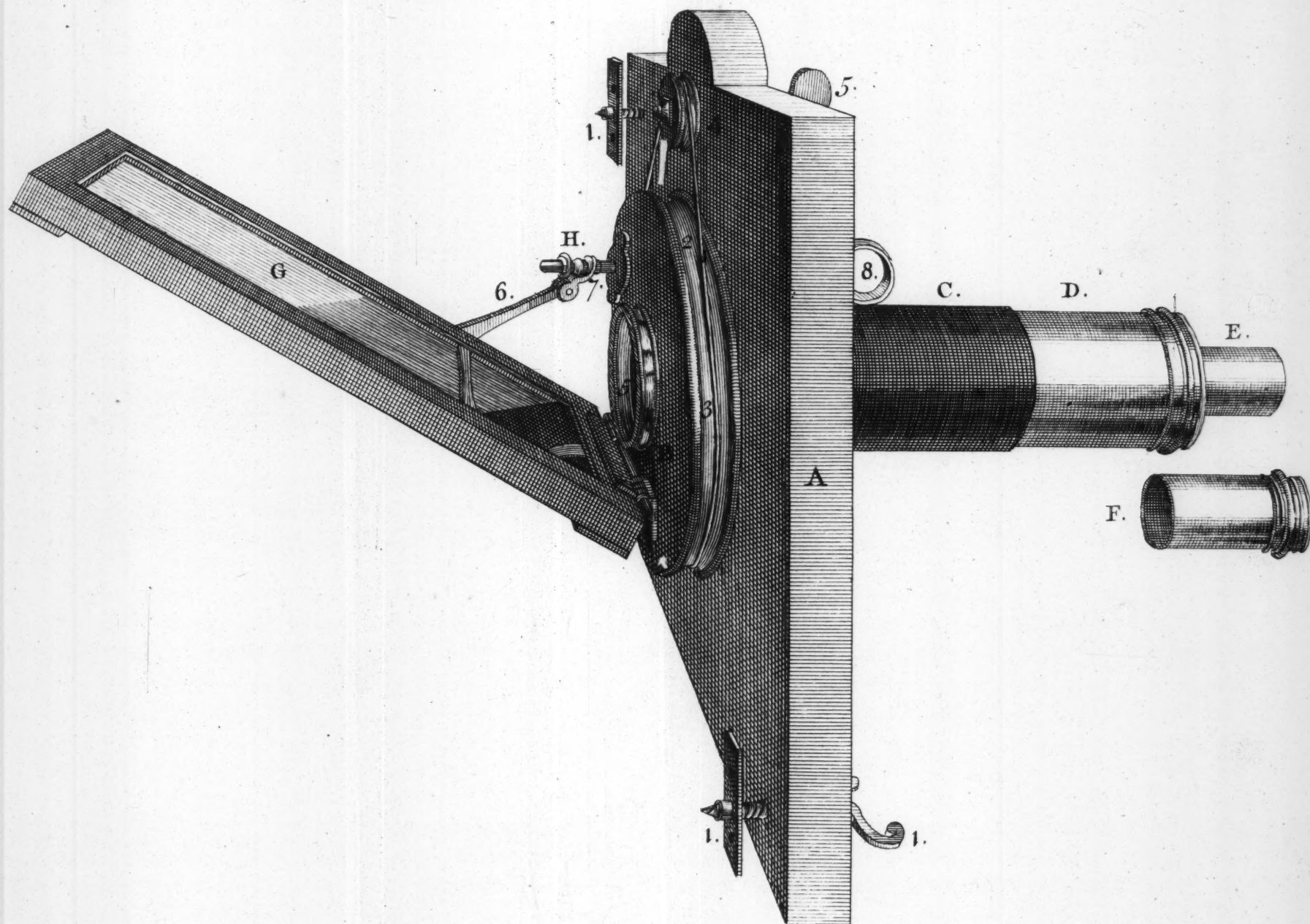
A Tube of Brass, cover'd with black Skin C, which screws into the Middle of the circular Piece of Mahogany, and becomes a Case for the uncover'd Brass Tube D, to be drawn backwards and forwards in.

To the End of this last mention'd Tube D, is join'd a smaller Tube, E, about one Inch in Length.

F. Is another brass Tube, one Inch and a half long, made to slide over the above-describ'd Tube E. To the End thereof the *Microscope* must be screw'd when we come to use it.

5. A *Convex-Lens*, whose Focus is at about 12 Inches, design'd to collect the Sun's Rays, and throw them more strongly upon the Object.

G. A Looking-Glass, seven Inches long, and two Inches and a half wide, in a wooden Frame, fasten'd by Hinges to the circular Piece of Mahogany, and turning about therewith, by Means of the Cat-Gut before describ'd.



H. A jointed Wire, partly Brass and partly Iron, the brass Part whereof, 6, which is flat, being fasten'd to the Looking-Glass, and the iron Part, which is round, 7, passing through the wooden Frame, puts it in the Observer's Power, by pulling it backwards or forwards, to raise or lower the Glass, as the Sun's Height shall make it convenient.

8. A brass Ring at the End of the jointed Wire, whereby to manage it with the greater Ease.

N. B. The Ends of the Cat-Gut are fasten'd to a brass Pin ; by turning of which it may be braced up, if at any time it becomes too slack. This Pin lying behind could not be shewn in the Draught.

The Manner of employing the Solar Microscope.

A round Hole being made in a Window-shutter, of a Size to receive a circular Piece of Mahogany, B, let the Room be made as dark as possible ; then putting the Looking-Glass, G, with the projecting circular Groove through the said Hole, fasten the square Frame A, to the Shutter by its two Screws and Nuts 1. 1.

This done, adjust your Looking-Glass to the Altitude and Situation of the Sun, by means of the jointed Wire, H, together with the Cat-Gut and Pulley 3, 4. For, the first of these raising or lowering the Glass, and the other turning it about to either Side, afford two Motions ; which may easily be so managed as to bring the Glass to a right Position ; that is, to make it reflect the Sun's Rays, directly through the Lens 5, upon the paper Screen, and form thereon a Spot of Light exactly round.

As soon as this is obtain'd, screw the Tube, cover'd with Black, C, into the brass Collar provided for it in the middle of your Wood-work, taking Care not to alter the Looking-Glass ; then screwing the Magnifier, you chuse to employ, to the End of your *Microscope* in the usual Manner, take out the Lens at the other End

thereof, and place a Slider, containing the Object you intend to examine, between the thin brass Plates, as in the other Ways of using the *Microscope*.

Things being thus prepar'd, screw the short Tube F, fast to the Body of your *Microscope*; then slip it over the small End E of the Tube D, and pull out the said Tube D, more or less, as your Object is capable of enduring the Sun's Heat.

The Focus of the Lens 5, without-side the Window, is about twelve Inches, and a proper Distance for Things that have no Life is, commonly, at about ten or eleven Inches; but it must be shorten'd for living Objects, till they can well sustain the Heat. If the Light falls not exactly right, when the *Microscope* is apply'd to the Tube E, by a gentle Motion of the jointed Wire H, and Pulley 4, you may Easily direct the Sun's Rays through the Axis of the Microscopic Lens.

The short Brass Tube F, whereto your *Microscope* is screw'd, by sliding over the Tube E easily, and turning it either one Way or other, will enable you to bring the Object to the true Focal Distance, and also to move it round without disordering it.

Tho' obtaining a perfectly Circular Spot of Light upon the Screen, before you apply the *Microscope*, is a certain Proof that your Looking-Glass is adjusted Right, that Proof must not always be expected; for the Sun is so low in Winter, that (if it shines in a direct Line against the Window) it cannot then afford a Spot of Light quite round; however, if the Day be clear, the Sun bright, and its Situation on one side of you, it will shew Objects very agreeably even in *December*.

The properest Magnifiers for the Solar *Microscope* are, in general, the fourth, fifth, or sixth.

As Mention has been often made of a Screen, to throw the Image of the Object on; it is proper to take Notice, that there are two Sorts of Screens, of different

different Sizes, useful for this Purpose: The smaller Sort, is made of a Single Sheet of Elephant Paper, strained in a Frame, which slides up or down on a round Pillar of Mahogany, and may be turn'd about at Pleasure: The larger, contains several Sheets of the same Paper, pasted together, lin'd with Cloth, and let down with a Roller in the Manner of a large Map.

The Advantages of this Microscope beyond all other kinds are obvious at first Sight, since Objects may by it, be magnified almost to what Size you please, only by removing the Screen to a farther Distance from them: However, seeing them distinctly is the chief Thing to be regarded, and moving the Screen a little backwards or forwards will shew where that can best be done.

The Darkness of the Room and the Brightness of the Sun are likewise requisite to make the Image perfectly sharp and clear.

A little Practice will render the Application of the whole Apparatus easy and familiar.

As Gentlemen are frequently making Enquiries concerning the Invention and Improvement of the SOLAR MICROSCOPE, which is now Universally allow'd to be the most Agreeable and Entertaining Microscope yet known, as well as the most capable of making valuable Discoveries, I hope it will be excusable, if, in Order to satisfy their Curiosity, and prevent their being impos'd on by false Pretences, I give a short but true Account thereof.

This Instrument is not of *English* Invention, nor was ever known amongst Us, till about three Years ago, when Dr LIBERKUHNS, a Gentleman of *Prussia*, came from *Holland* hither, and brought it over with him: But, whether he met with it in his Travels, or was himself the Inventor, I shall not pretend to determine.

mine. He was however, most assuredly, the first Discoverer of it to Us ; and being an extraordinary good Mechanic and Workman, he ground and set his own Glasses with a great deal of Accuracy, and made the whole Apparatus with his own Hands.

Being of a communicative Temper, he shewed this curious Contrivance to several Gentlemen and Workmen ; nor was it long before Instruments were made in Imitation of His. In all these, the Tube thro' which the Sun's Rays pass on to the Object, was fastened to a Ball and Socket, in Order to direct it, as much as possible, against the Body of the Sun as it moves along the Heavens. But the Instrument, notwithstanding, could be employ'd a few Hours in a Day only : Which Inconvenience made the Invention less valued than it deserved.

To amend this, permit me with all Submission to declare, that Myself was the fortunate Person, who (from the ingenious Hint of a kind Friend that introduced me to Dr. LIBERKUHN) began to consider, that a plain Looking-Glass could Reflect the Sun's Rays thro' the Tube placed Horizontally, at any Time of the Day, when the Sun is a few Degrees above the Horizon, or even at its Highest Altitude. And, from that Consideration, we first contrived an Apparatus with such a Looking-Glass affix'd thereto.

Since which Time, being Honour'd with the Favour, Advice, and Assistance of several Gentlemen of the greatest Understanding and Abilities, I have been thereby enabled to alter and improve this Instrument, from Time to Time, till it arrived at the Degree of Perfection it appears to have at present.

*Fleet-street, Feb.
17th, 1743.*

JOHN CUFF.

12 JY 64

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